

2/PRTS

107518856^[510.1115]
DT01 Rec'd PCT/PTC 17 DEC 2004

METHOD FOR MANUFACTURING A BRAKE DISK AND BRAKE DISK.

[0001] The present invention relates to a method for manufacturing a brake disk according to Claim 1 and to a brake disk according to the preamble of Claim 6.

[0002] Brake noise and excessive wear in disk brake systems are often attributable to the phenomenon of shielding. Shielding is understood as an axial distortion of the brake disk caused by radial thermal expansion.

[0003] Shielding may be reduced considerably by decoupling the friction ring from the brake disk chamber. DE 199 31 140 A1, for example, describes the manufacture of a composite cast brake disk made of a chamber and a friction ring. A chamber is provided in this case with radial retaining bolts and is placed into a casting mold. A casting is then made around the chamber in the region of the retaining bolts, and the friction ring is formed. Although in this brake disk there is a separation between chamber and friction ring, the radial expansion is limited by the rigid retaining bolts.

[0004] DE 195 05 112 A1 describes a method for composite casting for a brake disk. A tooth-shaped metal band is inserted between the chamber and friction ring, and a casting is made around the metal band, which is then exposed again. Since the metal band does not bond with the casting, the chamber and the friction ring are decoupled after the band is exposed. The disadvantage here is the complicated procedure, and a tight axial fit is difficult to ensure.

[0005] The object of the present invention is to provide a method for manufacturing a brake disk and a brake disk which considerably reduces shielding and which may cost-effectively be suitable for mass production.

[0006] The object is achieved by a method as recited in Claim 1 and a brake disk as recited in Claim 6.

[0007] According to the method of the present invention, a plurality of pairs of bodies inserted into one another and axially movable with respect to one another are placed in a casting core. The bodies inserted into one another are placed in the casting core in such a way that their axis of movement with respect to the brake disk points largely in a radially outward direction.

[0008] The casting core is placed in a casting mold which is filled with liquid metal, preferably a ferrous metal, in the conventional manner. After solidifying, the core is removed and the bodies remain at least partly cast in as joining elements between a friction ring and a brake disk chamber.

[0009] The brake disk chamber and the friction ring are decoupled by the use of the method according to the present invention, whereby shielding is reduced, and they may be manufactured and/or joined via composite casting in a single operation, which considerably reduces production costs. As a rule, no additional joining agent is needed.

[0010] In principle, a pre-manufactured single component, such as the brake disk, the brake disk chamber, or the friction ring, may be placed in the casting mold and joined during casting via the bodies inserted into one another. One particular advantage of the method is that the brake disk chamber and the friction ring are cast and joined in a single casting operation.

[0011] The core and the casting mold are shaped such that they are filled together preferably via a gate. After solidifying, a bridge is thus formed between the brake disk chamber and friction ring, which is later removed preferably via a machining operation. A particularly homogeneous and low-shrinkage joint may be achieved using this filling method.

[0012] In another embodiment of the method according to the present invention, it is also possible to feed the brake disk chamber and the friction ring separately through a branched gate. No bridge requiring subsequent removal is needed in this case; however, the casting procedure is slightly more complex.

[0013] The bodies inserted into one another are preferably placed in a core box; core shooting is subsequently performed, the bodies being fixed by the molded and solidified core. This method is easy to automate and is therefore cost-effective.

[0014] The object of the present invention is furthermore achieved by a brake disk according to the present invention as recited in Claim 6. The brake disk is characterized by the fact that a brake disk chamber and a friction ring are joined by two or more pairs of bodies inserted into one another and axially movable with respect to one another. The brake disk chamber is joined to one of the two bodies inserted into one another, and the friction ring is joined to the other body. Since the two bodies are axially movable with respect to one another, the brake disk chamber and the friction ring may also radially expand with respect to one another. This considerably reduces shielding between the brake disk chamber and friction ring. The resulting advantages are lower brake noise, the reduction of brake-pad wear, and the reduction of microcracks in the friction ring caused by shielding. In particular, the reduction in microcracks results in a longer service life of the brake disk.

[0015] The bodies inserted into one another are preferably cast between the brake disk chamber and the friction ring. The two components are thus firmly joined.

[0016] The bodies inserted into one another preferably have a round, particularly preferably circular, cross section. Accordingly their geometric shape is cylindrical, an outer body being designed as a hollow cylinder (bushing) and an inner body also as a hollow cylinder or as a solid cylinder (bolt). Such an arrangement is advantageous for unimpeded mobility of the bodies with respect to one another.

[0017] Advantageous embodiments of the present invention are explained in detail with reference to the figures below and the example.

[0018] Figure 1 shows a cross section of a cast brake disk having a core.

[0019] Figure 2 shows a cross section of a brake disk according to Figure 1 after machining;

[0020] Figure 3 shows a longitudinal section of a brake disk according to Figure 2;

[0021] Figure 4 shows a longitudinal section of a brake disk.

Example

[0022] Ten pairs of two bodies each inserted into one another in the shape of cylindrical bushing pairs are placed in a core box in an annular shape (8, 10 in Figure 1). Core sand is shot into the core box and solidified. A solidified casting core (core) encloses bushing pairs 8, 10 in some areas, whereby bushing pairs 8, 10 are fixed in the core and become an integral part thereof.

[0023] The core is placed in a casting mold; the brake disk is cast using a method known per se. The metal is cast from a bottom of a friction ring area; the melt flows upward via bridge channels, which form bridges 12 in the cast brake disk, to a chamber area. The cast brake disk is then cooled down in a controlled manner.

[0024] Figure 1 shows a cross section of an unfinished brake disk 2 after casting, core 14 being still enclosed by brake disk 2. Brake disk 2 has a brake disk chamber (chamber) 4 and a friction ring 6. Chamber 4 and friction ring 6 are joined via bridges 12 in this state.

[0025] Core 14 is molded in such a way that there is a cavity in inner bushing 10, which is cast out via a stud 18. Stud 18 is firmly joined to inner bushing 10. Friction ring 6 is firmly joined to outer bushing 8.

[0026] In a subsequent operation, core 14 is removed and bridges 12 are wrung off. Figure 2 shows finished brake disk 2 from Figure 1. Chamber 4 is now joined to the friction ring only via bushings 8 and 10. Bushings 8 and 10 are axially movable with respect to one another, which allows for radial expansion with respect to chamber 4 and friction ring 6 in the direction of the arrow (Figure 2). When chamber 4 and friction ring 6 move radially, a gap 24 is used for equalization and for removing the cooling air conducted by friction ring 6. Open cavities 19 in the center of friction ring 6 form an internal ventilation of brake disk 2.

[0027] Figure 3 shows a section along line II in Figure 2. Embodiments for webs 20 or nubs 22 which form cavities 19 of the internal ventilation are shown here as examples. The view of Figure 2 shows casting 16, via which bushing 8 is cast into friction ring 6. Torque is transmitted from friction ring 6 to chamber 4 via cast stud 18.

[0028] In another embodiment of the present invention according to Figure 4, the bodies inserted into one another have the form of an external bushing 8 and an internal bolt 26. Bolt 26 is cast in the area of chamber 4. Torque is transmitted via bolt 26 as it is via cast stud 18 of Figure 3.

[0029] In the previous example, the bodies inserted into one another are shown having round cross sections. In addition to the round cross section, any other cross section is generally conceivable; however, the cross sections of the bodies should be concentric and should not change along an axis of movement. Furthermore, a rail joint, for example, in the form of a dovetail joint, may be expedient.

[0030] The term brake disk chamber is normally used for a retaining part which is used for joining the brake disk to a vehicle.

[0031] The brake disk is preferably cast using a ferrous metal; therefore, the joining bodies are also preferably made of a ferrous metal. Light metal castings may also be used in the present invention. The individual components of the brake disk may be made of different materials.

[0032] The bridges illustrated in Figure 2 run on an upper and a lower friction ring side, for example. They may have a circumferential or interrupted design and basically may be situated at any contact point of chamber 4 and friction ring 6.

[0033] Figures 1 through 4 show the arrangement of bodies (8, 10, 26) inserted into one another in such a way that they are essentially situated in the area of the friction ring. In an embodiment which is not illustrated, an outer body of the bodies inserted into one another is surrounded by a cast chamber and a joint similar to cast stud 18 in Figure 3 extends from a friction ring to the chamber and is joined there to an inner body of the bodies inserted into one another. A joint similar to bolts 26 in Figure 4 of the friction ring to the chamber is also expedient, the bolt being surrounded by the cast friction ring and being movably mounted in the bushing cast into the chamber.